“…now, for the rest of the story”

(thanks and a tip of the hat to Paul Harvey)

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Overview

- **Construction does not take place in a vacuum**
- **Other standardization efforts already exist in the larger context that will need to be acknowledged**
- **Work remains to be done in order fully to integrate the “intelligent job site” into the larger context (a two-way street)**

[If you’re interested in the FIATECH AEX project, ask me later]

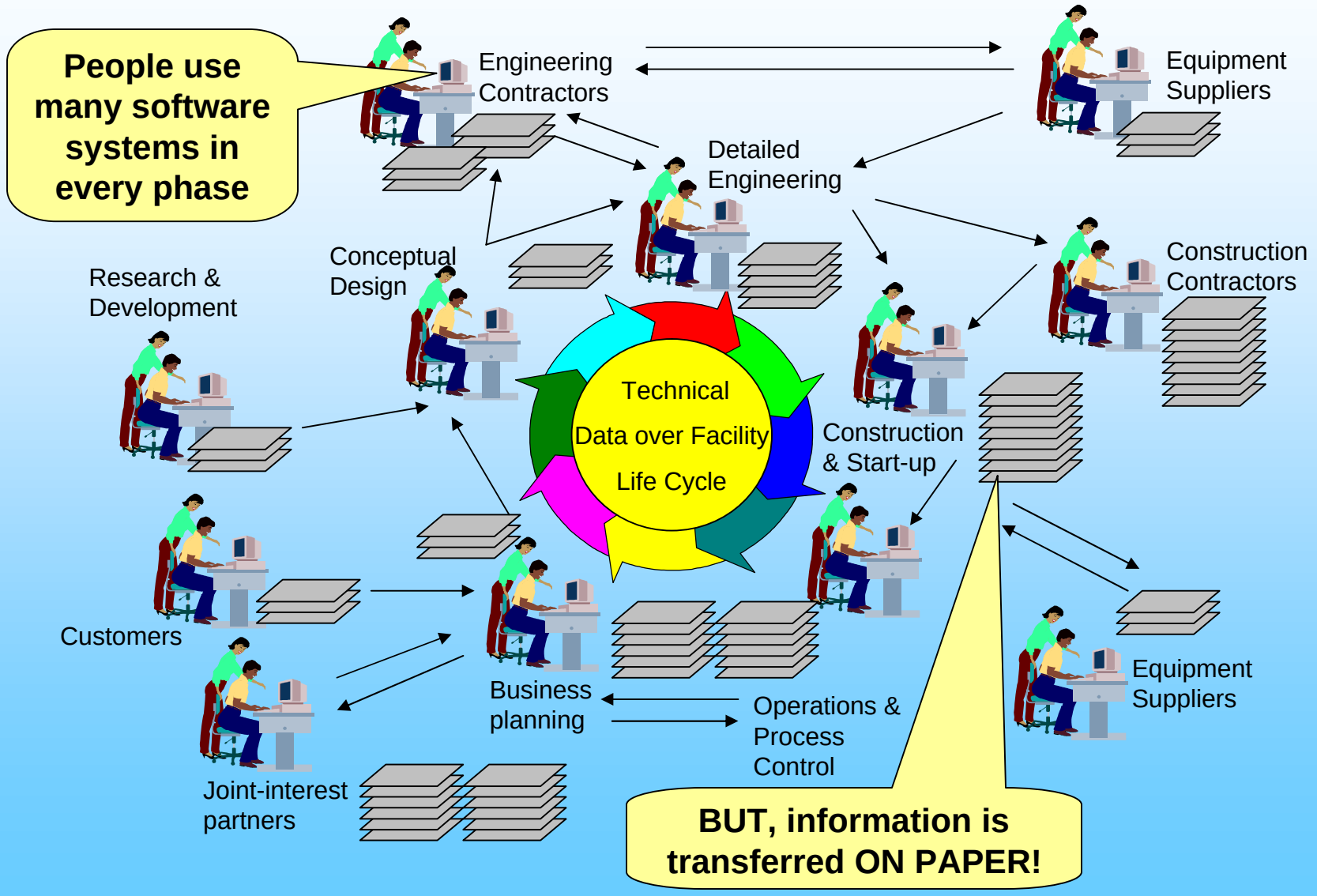
Business Roundtable study: A real business case exists for integration

- A 1997 analysis of more than 2000 capital projects representing US$300 billion in investment
  - effective project delivery systems result in a significant increase in ROI to owner (best case 22 percent / 15 percent average / worst case 9 percent)
  - effective project delivery systems reduce the project cost (best case $0.72 / $1 average / worst case $1.25)
  - effective project delivery systems improve operability of new facilities by 6 percent over industry average

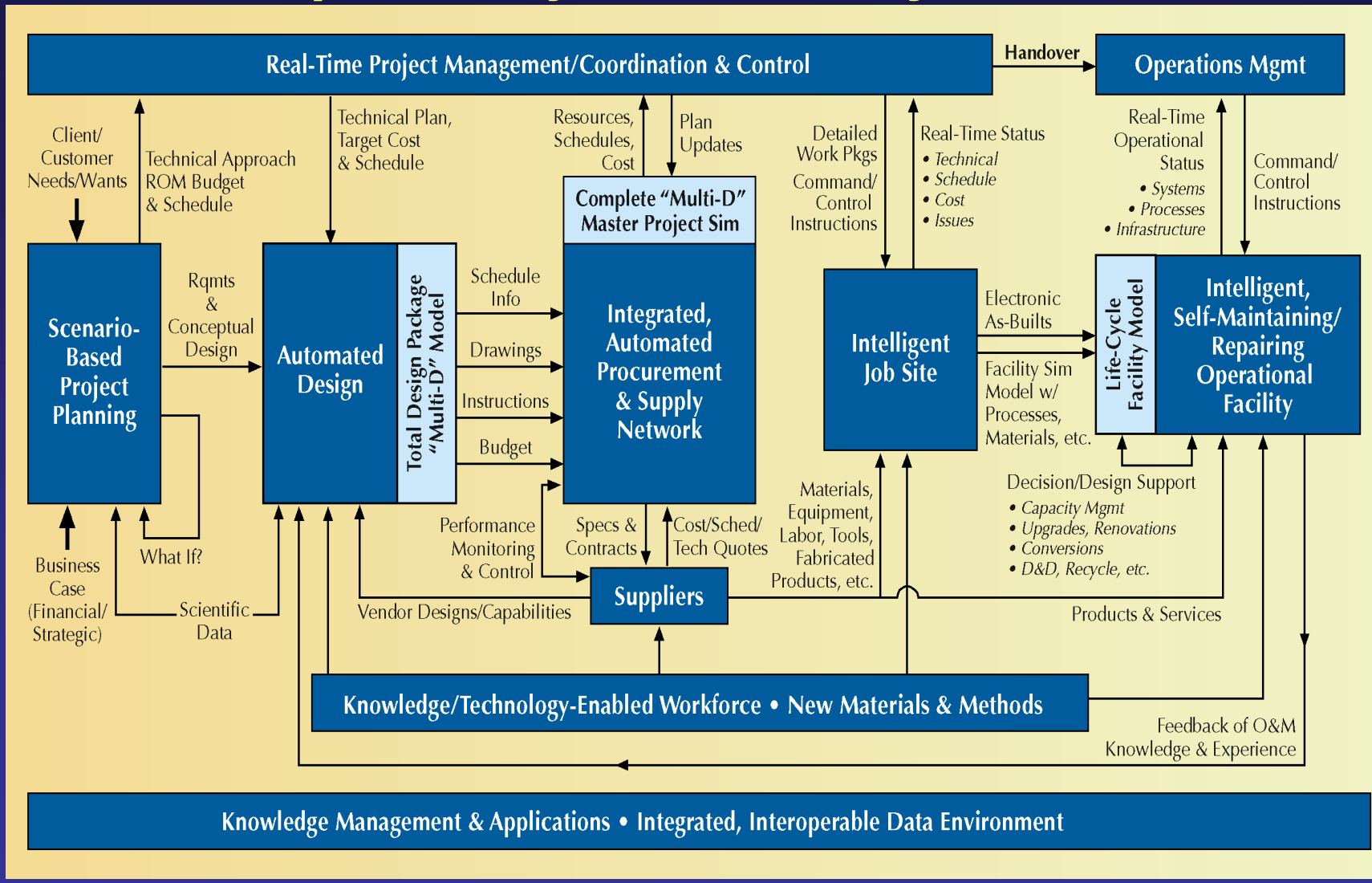
The Business Roundtable study, cont.

- Effective project delivery systems are created by integrated, empowered project teams (owner, contractor, suppliers)
  - result in the least project cost growth (~0 percent vs. 60 percent for “all contractor” team)
  - result in the shortest engineering and construction time (93 percent versus 112 percent “all contractor”)
  - result in short start-up time and good performance attainment

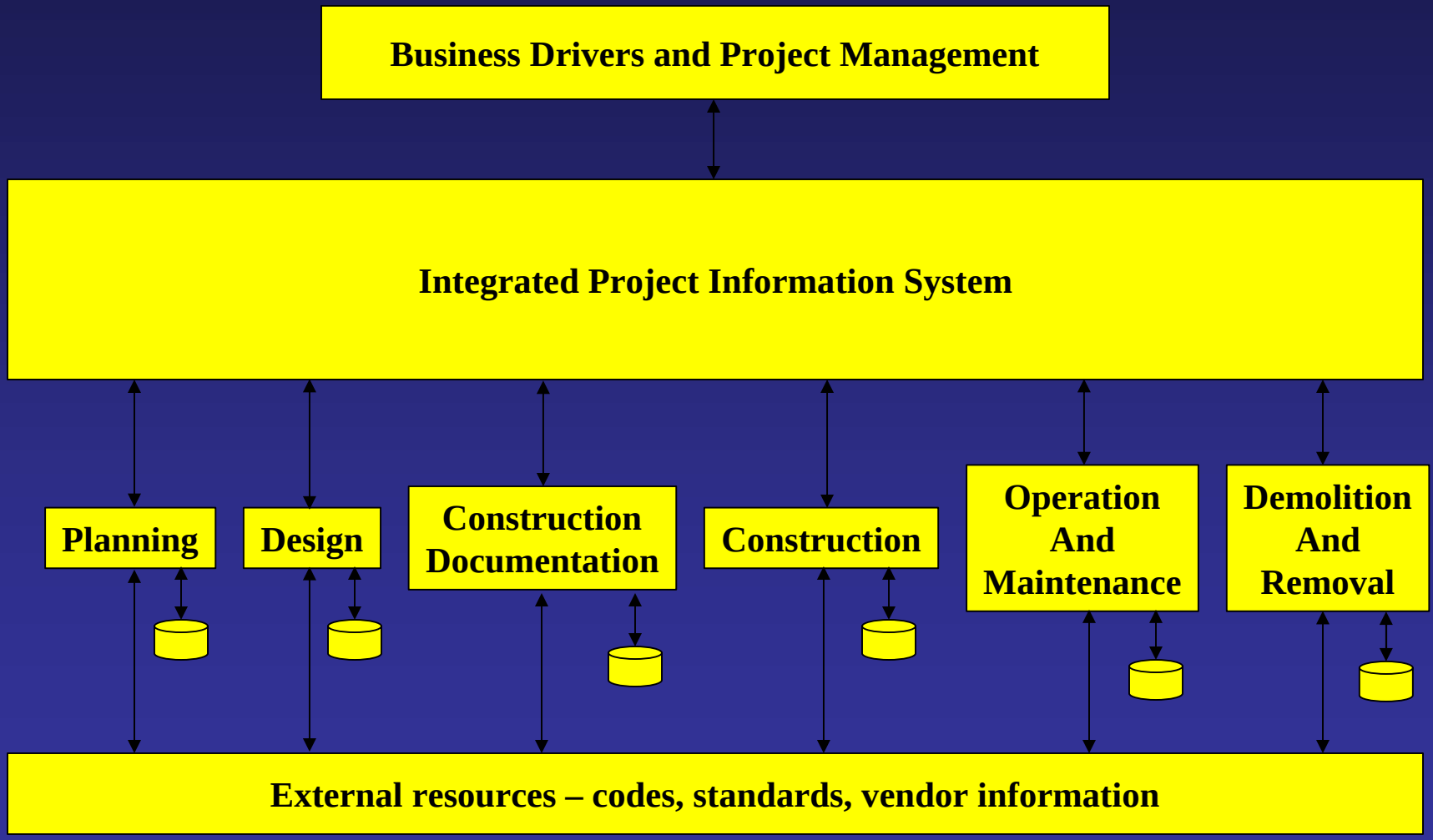
Lack of interoperability inhibits integration



FIATECH Vision of an Integrated and Automated Capital Projects Industry ala 2003



Woods Hole Vision ala 1980s



Evolution of model-based product data standardization

1980s – 1990s

Initial Graphics Exchange Specification (ANSI/IGES)

- Strictly product definition data
- Primarily geometry elements with associated attributes
-A force fit of drawing and model paradigms

Late 1980s – present

Standard For the Exchange of Product Model Data (ISO/STEP)

-Focus still on product definition data
-Acknowledges there is m'f'r'g process data
- Geometry now treated as a kind of attribute of an information object

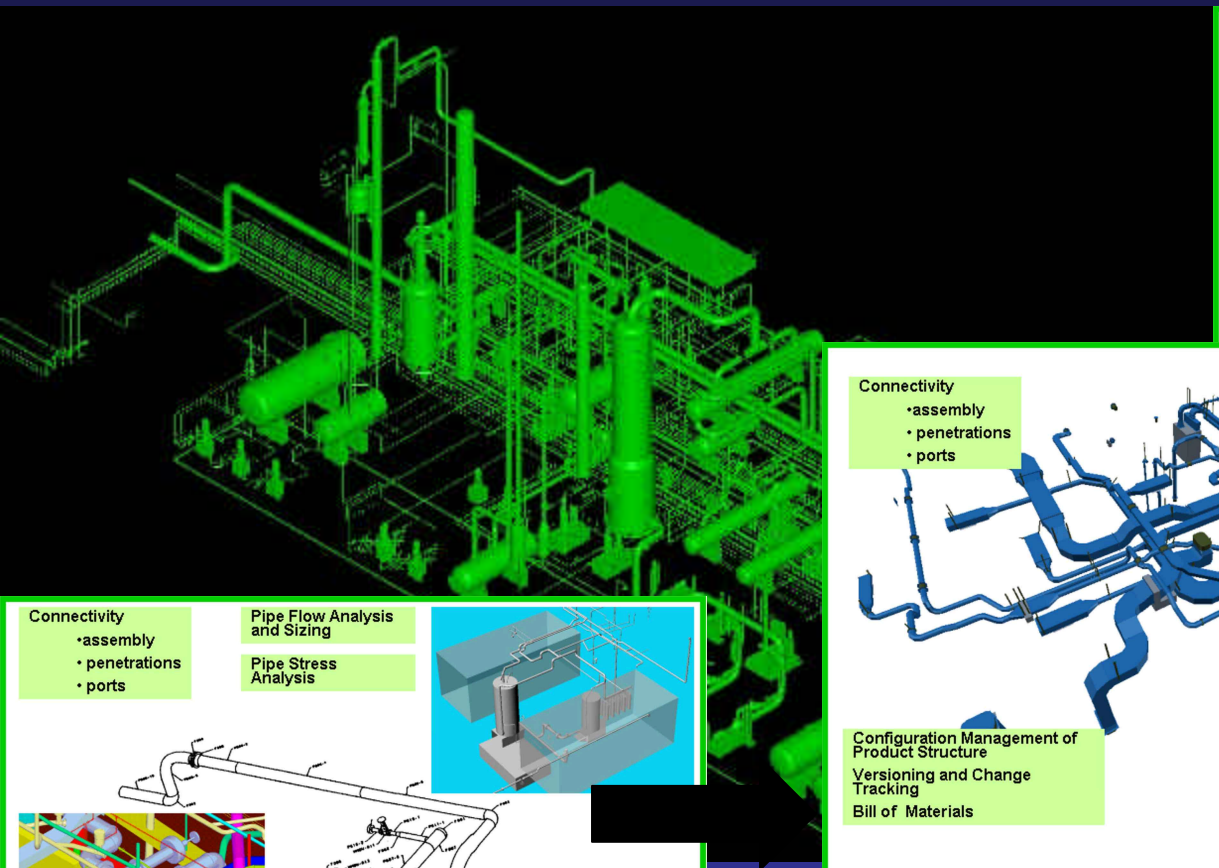
Mid 1990s – present

CIMsteel Integration Standards (CIS2)

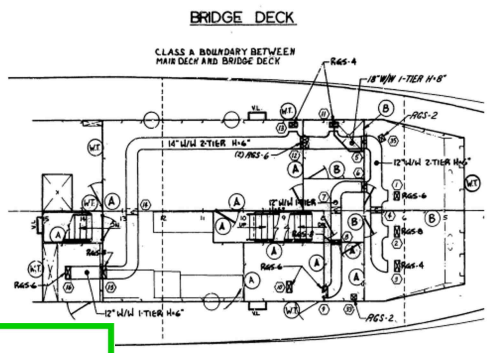
Industry Foundation Classes (IAI/IFC)

- STEP technology specialized to AEC
- Product/ process/ project object views
- Life cycle view

ISO STEP Application Protocol 227



Connectivity
- assembly
- penetrations
- ports



2-D and 3_-D Shape Representation
- Diagrammatic Presentation
- Solid Model Presentation
- Interference Analysis

Plant spatial configuration - cable trays

Connectivity
- assembly
- penetrations
- ports

Configuration Management of Product Structure
Versioning and Change Tracking
Bill of Materials

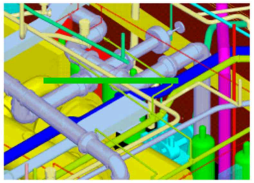
2-D and 3_-D Shape Representation
- Diagrammatic Presentation
- Solid Model Presentation
- Interference Analysis

AP227 Edition 2:draft, Plant spatial configuration - adds HVAC systems

Connectivity
- assembly
- penetrations
- ports

Pipe Flow Analysis and Sizing

Pipe Stress Analysis



Configuration Management of Product Structure
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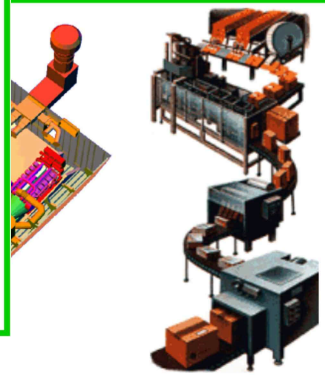
AP227:2001, Plant spatial configuration – piping systems

Product definition and fabrication



Configuration Management of Product Structure
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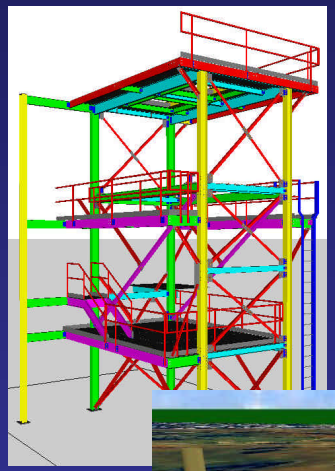
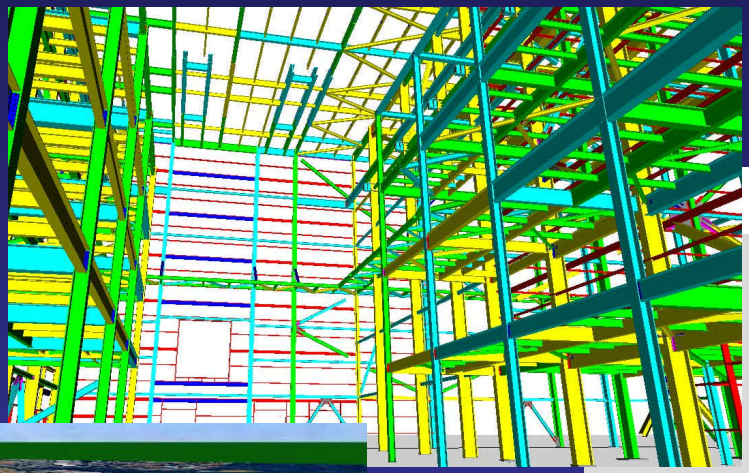
AP227 Edition 2:draft, Plant spatial configuration - adds mechanical systems

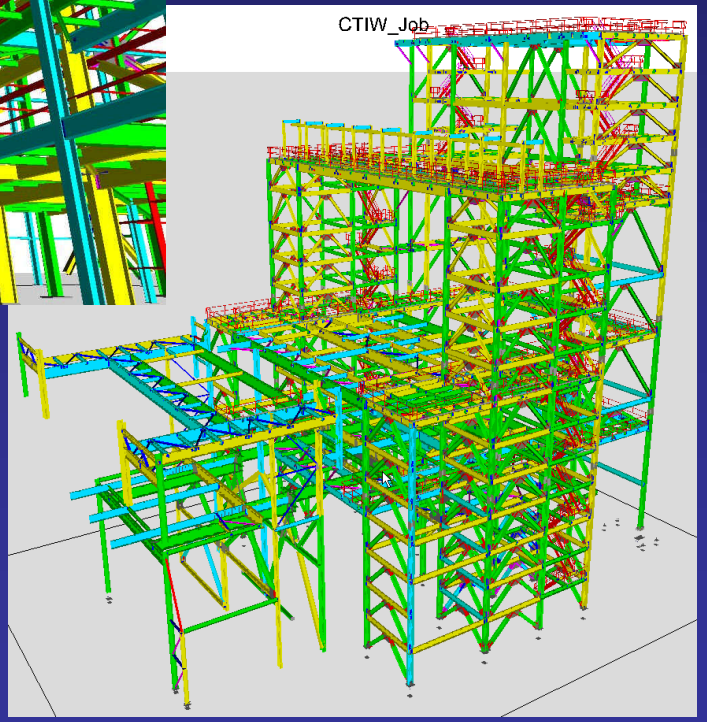
CIMsteel Integration Standard

CIS/2

Sharing steelwork information through design, analysis, detailing, fabrication, erection, and maintenance

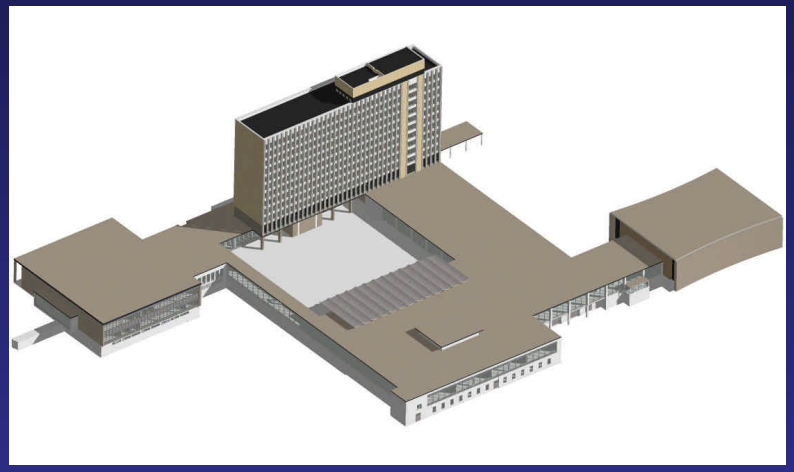


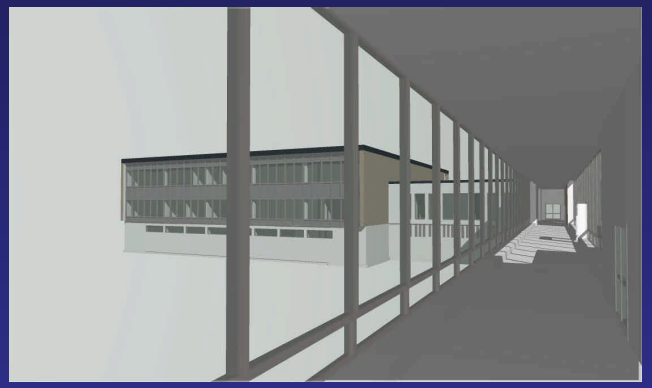


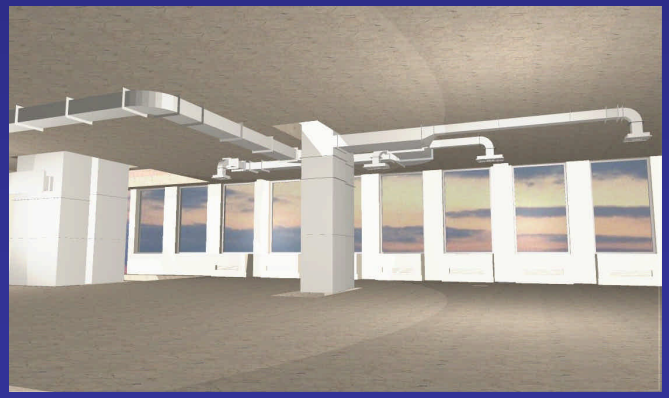


IAI Industry Foundation Classes

Sharing building information throughout the life cycle







What these representations share that is useful in construction phase

- Unique object identifiers – can be tied to material tracking and management (but…)
- Objects (may) have one or more geometric representations that lend themselves to recognition
- Object geometry is “grounded” e.g., it is referenced to a known coordinate reference system and CRSs can be nested; directly connects to onsite measurement
- Georeferencing supported (but not required)

What still needs to be done vis-a-viz construction

- Object names, ids, and similar tags generally are not predefined (…this really is an industry issue)
- Where industry “standard” identifiers exist, they often don’t hold up to automation (e.g., ASTM/AISC shape nomenclature had to be rectified)
- With the exception of structural steelwork (CIS2), there is no guarantee that the geometric representation of an object supports robust object recognition
- Information representations differ in the standards despite common heritage; can the industry agree a shared, dummied-down representation suitable for construction purposes?

What still needs to be done vis-a-viz construction

- Many of the objects that show up on the construction site are prefabricated; who should model them to the degree needed on the site?
- Some adjustments to the standardized representations would make it easier to capture the “as is” condition
- It is easy to see how to compare an “as designed” model to an “as is” model, but there is no consensus on how to report the result

Useful URLs

- ISO 10303 (STEP)
  - http://www.tc184-sc4.org
- CIMsteel Integration Standards (CIS/2)
  - http://www.aisc.org/cis2
  - http://www.steel-sci.org
- IAI/IFC
  - http://www.iai-na.org
  - http://www.iai-international.org
- http://cic.nist.gov